SBE Shasta I Service Manual

Shasta I

MODEL SBE-31 CB

SERVICE MANUAL

SBE®

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SECTION 1
GENERAL

1.1 CUSTOMER SERVICE

The SBE Technical Services Department functions as a source of information on the application, installation and use of SBE products. In addition, the Technical Services Department provides technical consultation on service problems and availability of local and factory repair facilities.

In any communications to the Technical Services Department, please include a complete description of your problems or needs, including model and serial numbers of the unit or units in question, accessories being used, any modifications or attachments in use, or any non-standard installation details.

For assistance on any of the above matters, please contact SBE, Incorporated, Technical Services Department, 220 Airport Boulevard, Watsonville, California 95076. Phone: 408/722-4177.

1.2 PARTS ORDERS

SBE original replacement parts are available from the Factory Parts Department at 1045 Main Street, Watsonville, California 95076.

When ordering parts, please supply the following information:

Model number of the unit.
Serial number of the unit.
Part number.
Description of the part.

1.3 FACTORY RETURNS

Repair services are available locally through SBE Certified Service Stations across the country. A list of these Service Stations is available upon request from the Technical Services Department. Do not return any merchandise to the Factory without authorization from the Factory.

SECTION 2

SPECIFICATIONS

2.1 GENERAL

Channels	6
Frequency	26.965 to 27.255 MHz
Frequency Control	Precision Quartz Crystal
Frequency Tolerance	0.003%
Operating Temperature Range	−20° C to +50° C
Microphone	Internal speaker operates as dynamic microphone in Transmit Mode.
Operating Power	Batteries (Self-contained) or with external accessory power supply.
Operating Voltage	12.5 VDC Nominal
Size	10 3/4"H (274mm), 2 1/2"D (64mm), 3 3/8"W (86mm)
Weight	1.5 pounds, 0.68 Kg. (Less Batteries)
Battery Types	(Not Supplied) Eight (8) AA-size 1.5V flashlight cells or Ten (10) AA-size Rechargeable Ni/cad cells.
Recharge Provisions	Receptacle provided for accessory external charger for recharging Ni/cad batteries when used.

2.2 TRANSMITTER

Power Output	High Power 3 watts nominal Low Power 1 watt nominal
Current Drain	Full Modulation High Power .48A Low Power .34A
Modulation	AM, 100% capability
Frequency Response	300-3KHz ±3dB

2.3 RECEIVER

Sensitivity	1μV for 10db S+N/N Ratio, 0.2 watts audio out
Selectivity	6db @ 3KHz, 60db @ 10KHz

Spurious	Down 60db or greater
AGC Response	Less than 10db for 10-100,000μV
Squelch	Threshold, Less than 1μV Opens on 100-500μV
Audio Output	0.5 watts @ 10% distortion
Frequency Response	300-3KHz, ±3db
Earphone	Plug provided for earphone

2.4 PA SYSTEM

Power Output	0.3 watts into external 16Ω speaker at 10% distortion
Frequency Response	300-3KHz, ±3db
Impedance of Internal Speaker	16Ω

2.5 ANTENNAS

Internal	Collapsible whip, 1/8 wave length
External	Provisions for external antenna resonant type, 50Ω, unbalanced.

SECTION 3

INSTALLATION

3.1 BATTERY INSTALLATION

The Shasta I requires either eight, 1.5 volt, size "AA" penlite cells or ten, 1.25 volt size "AA" rechargeable nickle cadmium cells. To install, loosen the screw at each end of the radio and place the batteries as shown in the battery chart.

The two "dummy batteries" must be installed if dry batteries are used.

3.2 BATTERY CHARGING

A battery charger with an output voltage of 12.5 volts @ 50 MA is required to charge nickle cadmium batteries. Connect the charger's DC plug to the jack labeled CHG on the side of the Shasta I. Discharged cells will require about 14 hours to completely recharge.

3.3 EXTERNAL POWER OPERATION

The Shasta I may be operated directly from an external 12.5 VDC power source such as a vehicle electrical source or AC adapter designed for this purpose. The AC adapter should have a current capability of at least 1.0 amp. The external power source is connected to the PWR jack on the side of the transceiver.

3.4 EXTERNAL ANTENNA

A base station type or physically shortened antenna may be used with the Shasta I for extended range or operation in confined spaces. Connection is made to the EX ANT jack located on the side of the transceiver. The external antenna must be resonant at 27 MHz and have an impedance of 50Ω. The internal antenna must be collapsed when an external antenna is connected.

3.5 PUBLIC ADDRESS

The Shasta I may be used as a public address system by connecting a 16Ω external speaker to the PA jack. Place the PA-CB switch in the PA position, depress the push-to-talk button and speak into the speaker grill of the Shasta I. Direct the external speaker away from the transceiver to prevent feedback.

3.6 EXTERNAL MICROPHONE - EARPHONE

A suitable external microphone may be connected to the MIC jack. The push-to-talk button must be depressed for transmission. An earphone may be connected to the SPKR jack when private listening is desired. The internal speaker is disabled when the earphone is plugged in.

3.7 CRYSTAL INSTALLATION

The Shasta I is supplied with one set of channel 11 crystals installed in Channel 1. To install additional crystals for other channels, loosen the screw at each end of the transceiver and remove the back panel. Matched crystal pairs may be obtained from your SBE distributor.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION

The SBE-31CB is an AM transceiver with a single-conversion receiver using an intermediate frequency of 455 KHz.

Refer to the block and schematic diagrams while following the circuit description.

4.2 RECEIVER

GENERAL

In the receive mode, the RF signal is fed from the antenna to the RF amp (Q1). The amplified RF signal is then fed to Q2 – the mixer – where it is mixed with an injection signal, from the RX OSCILLATOR Q5, 455 KHz below the receive channel frequency. The filter formed by T3 selects the 455 KHz converted signal to be fed to the 1st IF amplifier Q3, through ceramic filter CF-1 and to the 2nd IF amplifier Q4. The amplified IF signal is then detected by D3. After passing through the automatic noise limiter D4, the detected audio signal is applied across potentiometer VR1 – the volume control. The audio signal developed on the VR1 wiper is then fed to the 1st AUDIO AMP Q9. The output of Q9 is transformer coupled to push-pull speaker driver amplifier Q10 and Q11.

AUTOMATIC GAIN CONTROL CIRCUIT

The AGC (Automatic Gain Control) reduces the gain of the RF and IF amplifiers in response to a strong signal by lowering their bias voltage. The rectified output of D3 is filtered by R21 and C14 to produce the AGC voltage which is then fed to the base of Q1 by R2, Q2 by R8, Q3 by R11, and Q4 by R15.

AUTOMATIC NOISE LIMITER

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified. R24 and R27 form a voltage divider that biases the anode of D4 – the ANL diode – slightly positive. The audio output from the detector diode D3 is fed through R20 and R22 to C20 where it is filtered and then fed through R23 to the cathode of D4. The detector output is also fed to the anode of D4 through DC blocking capacitor C19. Since the audio signal is negative, the signal at the cathode is normally more negative than the anode and the diode is forward biased providing a low impedance path for the audio to the first audio stage. When a noise pulse appears in the output of the detector, the time constant of R22 and C20 prevents the cathode from responding as fast as the anode. The anode is thus driven more negative than the cathode causing D4 to become backed biased. D4 then becomes a high impedance that blocks the noise.

SQUELCH CIRCUIT

The squelch circuit turns the audio off when the received signal is less than the threshold level as determined by the squelch control – VR2. Raising the wiper on VR2 tends to forward bias the base of Q6 turning it on. Q6 on turns Q7 off which then turns Q8 on. With Q8 on, the audio output of Q9 is shunted to ground thus preventing amplification of the audio signal. As the received signal becomes

stronger, the AGC voltage lowers the bias on the base of Q6. Lowering the base voltage on Q6 turns Q6 off, Q7 on, and Q8 off permitting IC1 to amplify audio. Thus raising the wiper on VR2 increases the threshold level a signal must overcome to turn Q8 off and permit IC1 to amplify audio.

4.3 TRANSMITTER

GENERAL

In transmit mode, the output of oscillator Q10 is fed through band pass filter T7 to the TX DRIVER Q11 and then to the TX FINAL Q12. The output of the TX FINAL is then fed through second harmonic filter L7, C57 and low pass filter C58, L8, and C59, and antenna loading coil L1 to the antenna. Modulation is accomplished by driving the base and collector of the TX DRIVER and the collector TX FINAL from the bottom of the secondary of T5.

OVERMODULATION LIMITER

The OML regulates the gain of the audio amplifier so as to accommodate a wide range of voice levels without overmodulating the carrier. The audio signal is fed from the secondary of the audio output transformer T5 through D10, R45, and C38 across the OML ADJ VR4 to D7 and D8 where it is rectified. The rectified signal is then filtered by C27. When the amplifier is idle, R34 and R35 divide the voltage on C27 down to about 4 volts. As the audio level increases, the rectified signal increases the voltage on C27. If this voltage overcomes the 6.5 volt zener enough to forward bias the base of Q8, Q8 will turn on and shunt the audio signal going to IC1 to ground. As the sound level into the MIC increases the voltage on C27 will rise and thus lower the amplification of the sound.

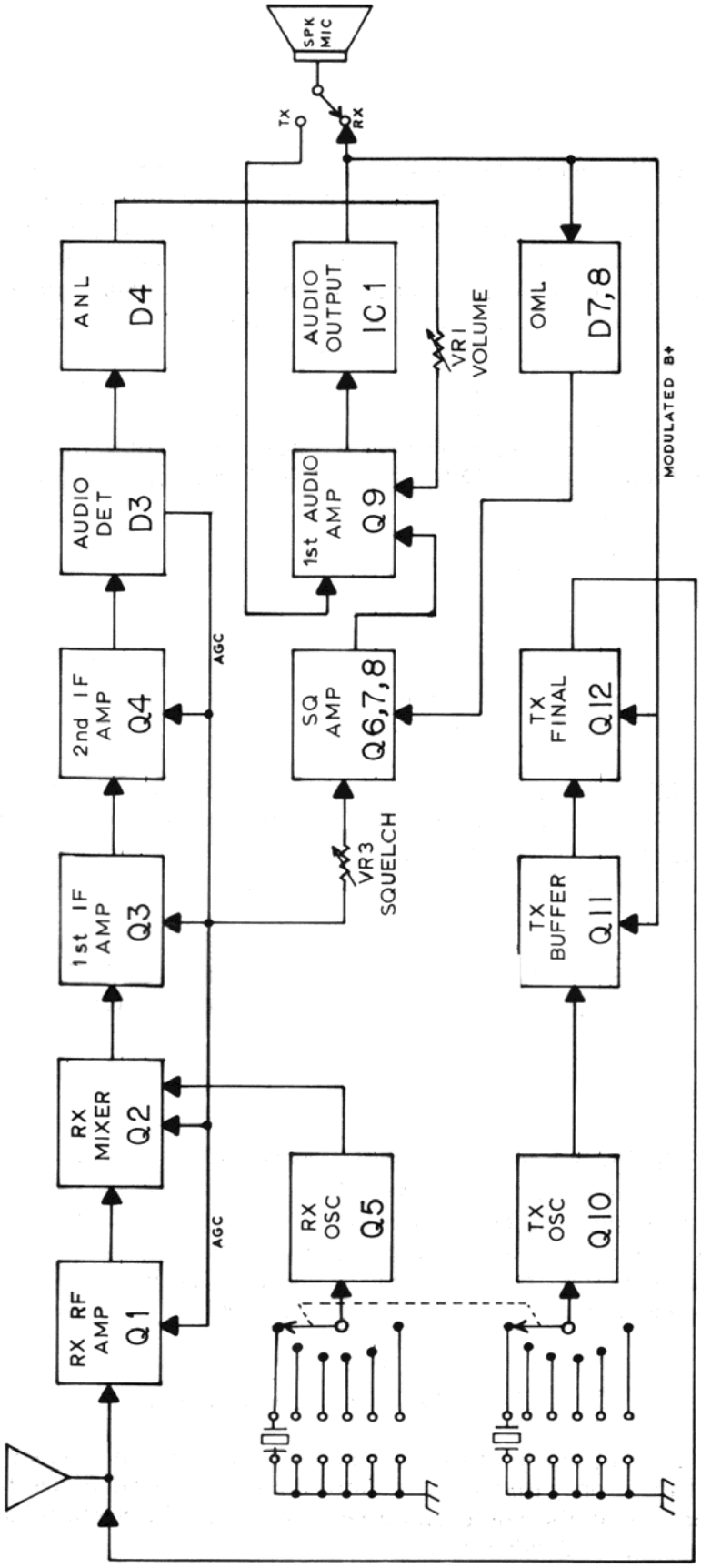
METER CIRCUIT

The front panel meter M monitors battery condition, signal strength and output power. When S5 is up, the meter is connected to the output of the RX detector D3 and TX FINAL Q12. When S5 is down, the meter is connected through R58 to the battery.

AUDIO AMPLIFIER

The AUDIO AMPLIFIER is used in transmit mode to amplify the audio from an external MIC or internal speaker (used as a microphone) to modulate the transmitter; in receive mode to amplify the output of the detector and drive the internal or external speaker, and in PA mode to amplify the audio from an external MIC or internal speaker to drive an external speaker. The input signal is fed to the base of Q9, and from the collector of Q9 to the input of audio amp IC1. IC1 drives T5 – the modulator driver and T6 – the audio output transformer.

FIG. 4-1 TRANSCEIVER BLOCK DIAGRAM



SECTION 5

SERVICING

5.1 INTRODUCTION

Read this section carefully before attempting any repair of the SBE-31CB. Refer to the circuit description, block and schematic diagrams. The transistor case diagrams are shown on the schematic diagram. Refer to these diagrams before checking transistors. A component and foil layout print is provided to aid troubleshooting and alignment. Use only recommended replacement parts. Refer to the parts list in the back of this book. **Never replace blown fuses with higher rated ones or fast acting with slow blow.** To check operation of the unit, refer to Table 5-1 PERFORMANCE VERIFICATION PROCEDURE. Figures 5-2, 5-3, TRANSMITTER TEST CONNECTION and RECEIVER TEST CONNECTION respectively, show the proper manner to connect the unit to test instruments for performance verification or alignment. Table 5-12 lists RECOMMENDED TEST INSTRUMENTS. Tables 5-4, 5-6 show the proper TRANSMITTER ALIGNMENT PROCEDURE and RECEIVER ALIGNMENT PROCEDURE respectively. Figure 5-8 ALIGNMENT LAYOUT is placed near the alignment procedures to show alignment adjustments at a glance.

5.2 TEST SIGNALS

OSCILLOSCOPE WAVEFORMS are shown which were taken from various points in the SBE-31CB during normal operation. Figure 5-7 shows RF amplification through a properly aligned transmitter. Figure 5-7 shows 50%, 100% and overmodulation respectively.

VOLTAGE MEASUREMENTS are shown on the schematic diagram for normal operation. RECEIVER INJECTION VOLTAGES are given in Table 5-9. This table specifies the voltage level, carrier frequency and particular points in the receiver string at which a 30% – 1 KHz modulated signal injected through a .01 MFD capacitor should produce at least 2 VAC of audio across the speaker or 16Ω load plugged into the speaker jack, SPKR.

AGC VOLTAGES versus RF INPUT LEVEL are shown in Table 5-11. This table should be consulted before any adjustments are made on the squelch circuit since squelch is a function of AGC.

5.3 TROUBLESHOOTING

Troubleshooting the SBE-31CB transceiver is not essentially different than troubleshooting any other electronic device. Be a detective; suspect everything and everyone. Carefully inspect the unit for evidence of overheated components, cold solder joints, or tampering. Understand thoroughly the circuit description and block diagram. Try to start big and isolate the problem. Devise tests that will divide the transceiver in two and isolate the trouble to a particular half. Continue to divide into two parts until the trouble is located. For example, it is determined that a problem exists in a particular transceiver. The unit is divided into:

TRANSMITTER – RECEIVER.

Suppose that the transmitter puts out properly modulated carrier, but the receiver will not respond to a modulated RF signal at the proper frequency fed into the antenna jack. Since the transmitter modulates, it can be assumed that all of the audio amplifier is working. After checking the TX/RX switch and receiver B+, the receiver is then divided into:

BEFORE IF – IF and AFTER IF.

Table 5-9, RECEIVER INJECTION VOLTAGES, shows that the proper signal level to inject at the base of Q3 – the 1st IF AMP – to produce a 2 VAC signal at the speaker is 455 KHz @ 300μV through a .01 MFD capacitor. If the signal appears at the speaker, the problem is in the RF amplifier. Divide this and continue until the trouble is found.

This technique is sometimes called, "partitioning," "boxing-in-the-trouble," "divide and conquer," or "binary search"; it is mandatory for complex electronic systems, but can save time and energy on almost any electronic device.

A blown fuse should only be replaced by one of the proper rating and type. If the fuse blows again, replace it, but place an Ω meter at the power terminals in place of the supply. Make certain that the + side of the Ω meter is connected to the red power wire of the SBE-31CB. Some VOM's place the – side of the Ω meter out the red test jack. The push-to-talk and PA/CB switch can be used to start isolating the short. Shorts can also be located by connecting a lamp in series with the power supply. Intermittent shorts will cause the lamp to flash. A voltage drop will appear across the path of a continuous short.

The second harmonic trap (L7 and C57) is adjusted at the Factory; field adjustment should not be attempted without proper equipment.

FIG. 5-1 PERFORMANCE VERIFICATION PROCEDURE

TRANSMITTER

INITIAL SET-UP

Connect the transceiver to a 12.5 VDC supply. Connect a wattmeter, dummy load and oscilloscope to the antenna jack. (See Figure 5-2.)

STEP 1

Key the transmitter and observe that the wattmeter indicates an output of at least 0.5 watts (low), 2.5 watts (high).

STEP 2

Whistle into microphone with transmitter keyed. Check for 90-100% modulation. (See Figure 5-5.)

STEP 3

Connect counter to dummy load and check transmit frequencies on the channels installed. (See Table 5-10.)

RECEIVER

INITIAL SET-UP

Connect the transceiver to a 12.5 VDC supply. Connect an RF signal generator to the antenna jack and set to one of the transceiver's channels 30% – 1 KHz modulation.

Turn the volume control full clockwise and squelch control full counterclockwise. Connect 16Ω load to external speaker jack and connect an AC voltmeter to 16Ω load. (See Figure 5-3.)

STEP 1

Adjust signal generator for 0.7μV output. Verify that at least 2VAC appear across the 16Ω load.

STEP 2

Increase signal generator output to 200μV. Rotate squelch knob full clockwise. Receiver should squelch.